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PATENT SPECIFICATION 947,963

DRAWINGS ATTACHED.

947,963

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COMPLETE SPECIFICATION.

Apparatus for Rendering Smokeless by Oxidation Small Agglomerates of Carbonaceous Substance.

We, HOUILLERES DU BASSIN DU NORD ET DU PAS-DE-CALAIS, a French Corporate Body, of 37 rue des Foulons, Douai (Nord), France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention concerns apparatus for the treatment of small agglomerates of carbonaceous material by means of gases and more particularly concerns oxidation treatment of small agglomerates of carbonaceous material to render them smokeless.

Many kinds of furnace are known for the heat treatment of carbonaceous materials; for example in Specification Nos. 716,537, 722,495, 812,822 and 908,606 we have disclosed apparatus for rendering agglomerates smokeless in which pitches or tarry products are present in the agglomerates as a binder. Known furnaces are more particularly useful for treating materials in a relatively coarse granular form, since the treatment of fine grains requires the material to be available in a definite thickness.

According to the present invention we provide an apparatus for the treatment of small agglomerates of carbonaceous material by means of gases which comprises an inclined column having two rows of parallel, laterally spaced inclined slats which define a path therebetween for material moving under gravity through the column, the rows of slats being such that treating gases can pass through them and contact the material.

This apparatus is particularly useful for the treatment of small and fragile grains as the material being treated moves under gravity.

The angles of inclination of the column governs the pressure applied to the grains and can therefore be varied according to the resistance to crushing of the grains to be treated. Preferably, the angle at which the column is inclined to the horizontal is about 5° more than the angle of repose of the material. According to another feature of the invention, two rows of slats divide the column into three longitudinally extending compartments so that the treating gases which pass through the path defined by the slats flow longitudinally in the two end compartments. According to another feature gas-heating means are provided in one end compartment and gas-circulating means are provided in the other end compartment.

The slats are of a shape, inclination and spacing such that, depending upon the inclination of the column, the formation on each slat of the angle of repose of the material from the inward edge of the top slat cannot lead to grains dropping outside the central compartment into the two end compartments.

The size of the slats governs the gas flow cross-section through the material moving therebetween and the angle of repose produced by one slat on the slat below it, while slat spacing also governs the same factors; these two features are therefore ultimately dependent upon the grain size of the substance and on the treatment to be given. Similarly, the inclination of the slats to the axis of the apparatus governs the gas flow cross-section and the angle of repose and therefore also depends upon the other factors mentioned above. In addition the inclination affects the friction between the grains of material and the slats and therefore depends upon the nature of the grains and upon the abradability thereof. The

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Price 25p

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nature of the slats determines the friction between the moving grains and the friability of the grains and it is therefore preferred to use stainless steel slats to keep this friction as low as possible.

As already mentioned, the inclination of the column can be varied in accordance with the resistance of the grains to crushing and upon the natural angle of repose which in turn depends upon the shape and size of the grains.

An apparatus according to the invention can therefore be used for treating a wide variety of products in varying conditions, merely by altering one of the constructional features and is very useful for rendering smokeless small grains which have small crushing strength during the softening period of the oxidising treatment and which are relatively friable. The absence of any mechanical element from the path in which the grains are treated helps to reduce breakage and to retain the grains in their original shape, a factor which increases the commercial value of the treated product.

The slats can have dimensions which vary between the individual rows and between the top and bottom of the column, depending upon the treatment which is required to give the material substance; similarly, the spacing between the slats in a single row can be varied in the same way in dependence upon different zones which are useful for treating the substance.

According to another feature of the invention, the column is non-displaceably secured at one point only, preferably in articulated fashion, for instance, along one of its edges, and is provided with means for sliding along a column-bearing frame, so that the column may be expanded freely. This simplifies the design of the apparatus and lowers the initial cost.

The central compartment may be connected at the top to a feed hopper in which sealing tightness is provided by the granular material, and the central compartment may be connected at the bottom to a conduit for removing the treated substance, the conduit having sealing means. Such means can take the form of a tank of water into which the removal conduit opens above means for removing the substance, such as a conveyor belt, such means being adapted to the size of the grains to be treated.

Of course, the rate of flow of the products—i.e., the duration of the treatment—depends upon the particular treatment required and, for any particular treatment, upon the grain size of the material to be treated. The rate of flow of material can be controlled by varying the speed of the removal; this can be achieved by, for example, using a metal or rubber conveyor belt having variable-speed driving means.

In the particular embodiment in which the treated products are removed below water, it is unnecessary to arrange for cooling within the column since cooling is effected directly in the water. Preferably the water is maintained at a constant level and at a constant temperature by a controlled supply of fresh water; the control may be effected, for instance, by a float valve. The temperature of the water can be maintained, for instance, at about 80° C., thus avoiding excessive cooling of the products and enabling them to be dried merely by aeration.

Surplus gases in the furnace can be removed either by an outlet in a pressure zone or by means of an extraction fan, in which event gases can be removed even from a negative-pressure zone; the piping for removing the smoke to a chimney is provided with a valve for controlling the smoke removal. The treatment gases can be supplied by an external source and introduced into the column via one end compartment thereof, such end compartment being opposite the end compartment which includes the gas-circulating means. The apparatus can have different nozzles for the introduction of different gases, such as air or water vapour, at appropriate places, to provide the correct atmosphere and temperature for the treatment to be carried out.

According to another feature of the apparatus according to the invention, at least one of the rows of slats can slide perpendicularly to its plane so that the thickness of the flow of granular material can be adjusted, thus varying the load borne by the grains being treated. The slats may be formed with apertures so that the treating gas flow cross-section can be as large as required in dependence upon the treatment being given. According to another feature, at least one of the rows of slats can slide parallel with its plane so that the path and the flow cross-section of the treating gases can be varied.

The apparatus may comprise a number of columns in series or in parallel and may be attached to one another by way of their side walls to reduce heat losses and the heat insulation required.

To improve the flow of material under treatment, at least the bottom row of slots of the apparatus may be vibrated thereby reducing the angle of repose and thus the necessary angle of inclination of the column; this is very useful for friable grains.

A preferred embodiment of the invention is hereinafter particularly described, by way of example only, with reference to the accompanying drawings in which:—

Figure 1 is a side elevation of the apparatus;

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Figure 2 is a front elevation of the apparatus shown in Figure 1;

Figure 3 is a sectional view taken along the line III—III of Figure 1; and

Figure 4 is a detailed view of the slats.

Referring to Figure 1, a column 1 is inclined to the vertical at an angle of 30° and has two rows 2, 3 of inclined slats, which are shown in detail in Figure 4.

As can be seen in Figure 3, the rows of slats divide the furnace into two end compartments 4, 5 and a central compartment 6, in which the material to be treated moves through the furnace under gravity. Two expansion valves 7, 8 are provided at the top of the column and the column is supported by a bearing device in the form of a stationary part 9 extending along its bottom edge and one bearing device in the form of a sliding element 10 which bears against a vertical part of framework 11. A fire box 12 is secured in the top part of compartment 4 and compartment 5 includes a smoke-circulating fan 13 which sucks in gases from above and delivers them downwards. A furnace feed hopper 14 is disposed in the top part of the central compartment 6 and is filled by means of a vibrating screen 15 which provision for removal of waste through a duct 16; the untreated material is supplied by conveyor means 17 to the vibrating screen 15.

A conduit 18 disposed at the bottom of the furnace removes the treated material and opens into a water-filled tank 19, in which a metal gauze 20 for removing the treated products is disposed; the gauze 20 can be moved continuously, in which event its movement is controlled by a variable-speed motor and determines the dwell time of the granular substance in the furnace. Alternatively, the gauze 20 can be controlled intermittently by means of a time switch mechanism. The gauze 20 removes the treated products to conveyor means 21. The tank 19 is supplied with water from a device 22 under the control of a float valve so that the level in the tank 19 remains substantially constant.

The furnace is divided into two different zones bounded by the position of the fan 13, zone A—B, which extends from the beginning of the furnace to the level of the fan and in which the gases from the fire box 12 pass through the central compartment 6 towards compartment 5; and the zone B—C which extends from the fan to the bottom part of the furnace and in which the central compartment 6 is flowed through by the gases supplied by the fan from compartment 5 to compartment 4.

Figure 2 shows, in addition to the elements illustrated in Figure 1, a conduit 23 for removal of furnace smoke; conduit 23 extends from a part of the furnace which is at a positive pressure and it is therefore unnecessary to provide a fan. The rate of flow of the smoke to be removed is controlled by a control valve 24 and the smoke passes to a chimney 25 which has provision for water spraying using water supplied by a pump 26.

An apparatus as described above is particularly useful for rendering relatively small coal agglomerates, having pitch or tarry products as binder, smokeless, but various agglomerates have been successfully treated with a furnace of this kind.

The following examples show the manner in which the apparatus is used for treating particular agglomerates.

EXAMPLE 1.

Coal agglomerates of from 6—10 mm. (average weight: 0.6 g.) of irregular shape and containing 93% of a lean coal, having 12% volatile ingredients, and 7% of coal pitch.

The furnace used to render these agglomerates smokeless was 6 metres long and 1 metre wide, the central compartment being 100 mm. thick and the other two compartments being each 500 mm. thick. The column was inclined at 75° to the horizontal and the slats inclined at 30° to the column axis, the fire box employing a gas burner.

The treatment takes the form of an inhibited exothermal reaction preceded by an oxidising initial heating. In this treatment, the gases in compartment 4 in the zone A—B are at a temperature of from 400 to 600° C., while the gases in compartment 5 in the same zone, such gases having passed through the agglomerates being treated, are at a temperature of from 250 to 280° C. The zone A—B is 2.5 metres long and the gases, before passing through the material, have about 12% oxygen content. The temperature and oxygen content of the gases enable them to effect an oxidising heating of the products from position A, at which the products are at ambient temperature, to position B, where the products are at a temperature of about 300° C.

The treatment gases are supplied to the zone B—C by the fan after losing a considerable proportion of their oxygen during the oxidising treatment. These gases are at a temperature of from about 250 to 280° C. in compartment 5 and flow through the material disposed therein to remove the heat evolved in the exothermal reaction. The gases in compartment 4 are therefore at a temperature of from about 350 to 370° C.

The furnace is provided with nozzles for the introduction of air to increase the oxygen contents of the gases and this air injection, and the required temperatures, can also be used to control the rate of gas removal to the chimney.

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The articles leaving the furnace drop into tank 19 where they are cooled in water at about 80° C., to be removed by an apertured metal belt.

The treatment time is from about 30—45 minutes for agglomerates of from about 6—10 mm. in size, and so furnace throughout is about one ton per hour.

EXAMPLE 2.

Conventional rounded agglomerates weighing 7 g. were treated in a column similar to that of Example 1 except that it was inclined at an angle of 60° to the horizontal and the central compartment was 200 mm. thick, the slats being at the same inclination to the axis of the column. The treatment time in this column was about 60 minutes.

WHAT WE CLAIM IS:—

1. Apparatus for the treatment of small agglomerates of carbonaceous material by means of gases which comprises an inclined column having two rows of parallel, laterally spaced, inclined slats which define a path therebetween for material moving under gravity through the column, the rows of slats being such that treating gases can pass through them and contact the material.

2. Apparatus according to Claim 1 in which the two rows of slats divide the column into three longitudinally extending compartments so that the treating gases which pass through the path defined by the slats flow longitudinally in the two end compartments.

3. Apparatus according to Claim 1 or 2 in which the column is inclined to the horizontal at an angle of about 5° more than the angle of repose of the material.

4. Apparatus according to Claim 2 or 3 in which gas heating means are provided in one end compartment and gas circulating means are provided in the other compartment.

5. Apparatus according to any of Claims 1 to 4 in which the column is non-displaceably secured at one position only and is provided with means for sliding along a column-bearing frame at another position so that the column may be expanded freely.

6. Apparatus according to any of Claims 1 to 5 in which the column is non-displaceably secured in an articulated fashion.

7. Apparatus according to any of Claims 1 to 6 in which the path for material defined by the slats is connected at the top to a feed hopper, the connection being sealed by the material, and at the bottom to a conduit for removing treated material, which conduit is provided with sealing means.

8. Apparatus according to Claim 7 in which the conduit sealing means comprises a water tank disposed above means for removing the treated material, the conduit opening into water contained in the tank.

9. Apparatus according to any of Claims 1 to 8 in which at least one of the rows of slats is mounted so as to be slidable perpendicularly to its plane whereby the thickness of the flow of material can be adjusted.

10. Apparatus according to any of Claims 1 to 9 in which the slats are formed with apertures so that the cross-section of the flow of treating gas is sufficient for the particular treatment to be carried out.

11. Apparatus according to any of Claims 1 to 10 in which at least one of the rows of slats is mounted so as to be slidable parallel with its plane so that the path and cross-section of flow of the treating gases can be varied.

12. Apparatus for the treatment of small agglomerates of carbonaceous material by means of gases substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

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947963 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

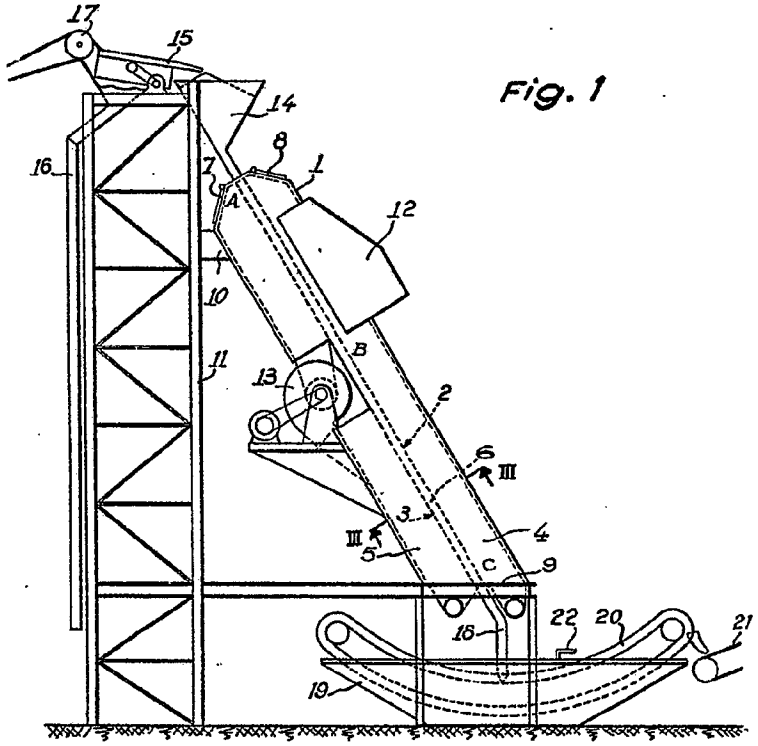

Fig. 1

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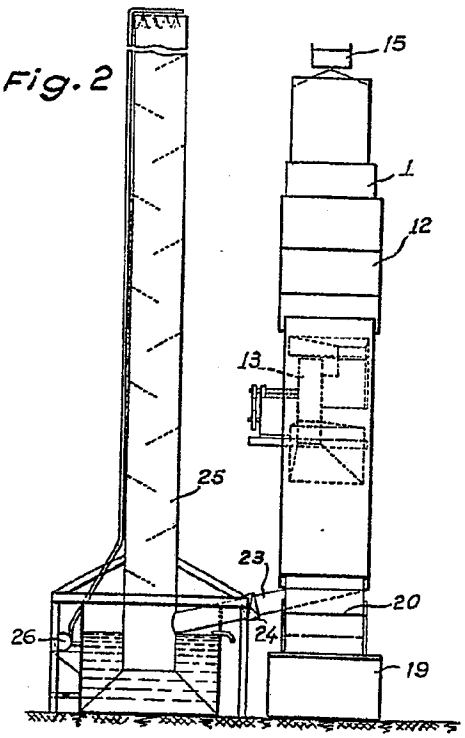
Fig. 2



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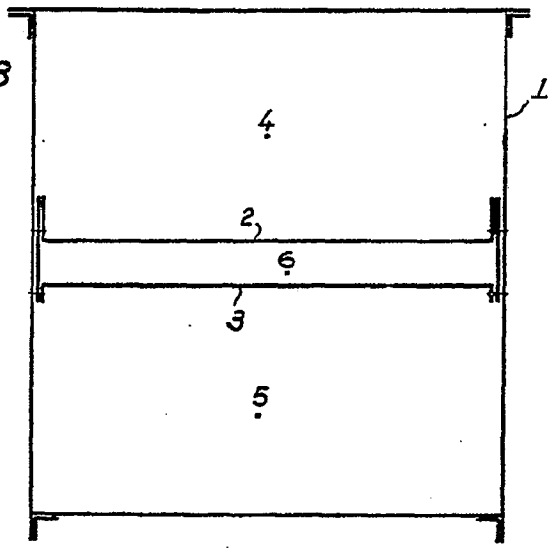
Sheets 2 & 3

Fig. 3



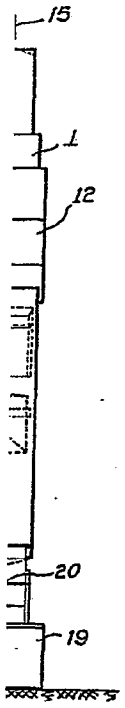
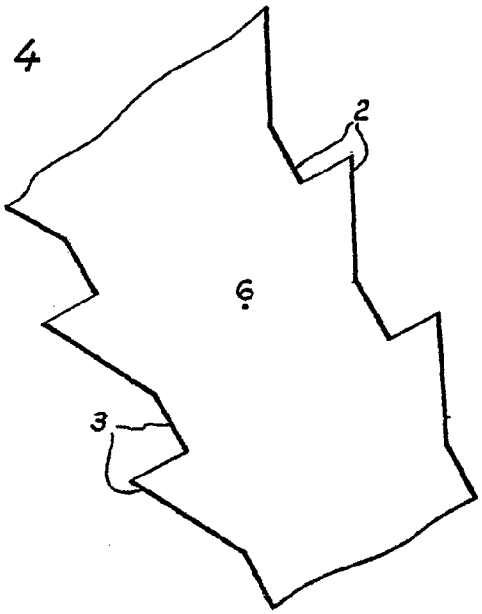


Fig. 4



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947963 COMPLETE SPECIFICATION

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Sheets 2 & 3

Fig. 2

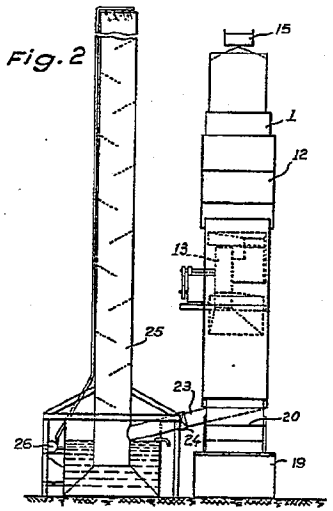

Fig. 3

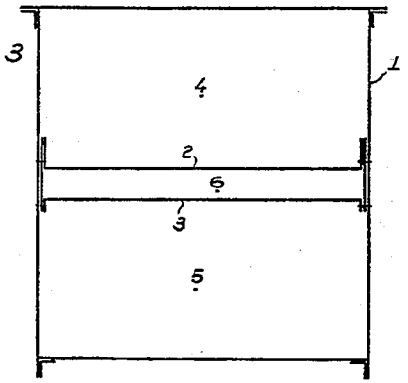

Fig. 4